User Manual
ARM-S

Advanced Radio Modem ®

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EC-DECLARATION OF CONFORMITY

Manufacturer's name : **ATIM SARL**
Responsible person : RAIMBERT Francis, Manager
Manufacturer's address : Les guillets – 38250 Villard de lans - France

Declares that the product:

Product name: ARM Radio Modems Range (Advanced Radio Modem)
Model number: ARM-S/ARM-E/ARM-D/ARM-X(433MHz/10mW,868MHz/500mW versions)
Intended use: Data Transmissions, Digital and analog values Transmissions.

complies with essential requirements of article 3 of R&TT 1999/5/EC Directive, if used for its intended use and that the following standard has been applied:

1 **SAFETY** (Article 3.1a of the 1999/5/EC Directive)
Applied standard(s) NF EN60950 Ed. 2000
(health) Recommendation 519 (July 1999)

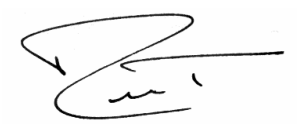
2 **Electromagnetic compatibility** (Article 3.1b of the 1999/5/EC Directive)
Applied standard(s) EN 301 489-3 v1.3.1

3 **Efficient use of the radio frequency spectrum** (Art.3.2 of the 1999/5/EC Directive)
Applied standard(s) ETSI EN300 220-3 v1.1.1

The ARM Radio Modems are equipped with antenna connectors to allow the use of following dedicated antennas for 433MHz and 868MHz Radios (depending of the version):

Antenna P/N	Gain	Frequencies	Description
ANT433-14S0.3	0dB	425.000-445.000	¼ wave omni directional antenna
ANT433-FSC	2dB	425.000-445.000	½ wave omni directional antenna
ANT433-12S3.8	2dB	425.000-445.000	½ wave omni directional antenna
ANT433-BZ	2dB	425.000-440.000	¾ wave omni directional antenna
ANT868-14S3.8	0dB	824.000-894.000	¼ wave omni directional antenna
ANT868-12FSC	2dB	824.000-896.000	½ wave omni directional antenna
ANT868-12S3.8	2dB	820.000-890.000	½ wave omni directional antenna
ANT868-BZ	2dB	824.000-894.000	¾ wave omni directional antenna

Villard de lans, January 10th 2005



Francis RAIMBERT, Manager.

1 PRESENTATION

This guide contains main information for a quick setup of the ARM-S radio modem.
For more details, it is recommended to refer to the User Manual.
ATIM keeps the right to modify the features of the product and the information of the User Manual without any notice.
For technical support, contact our distributors or resellers.

1.1 INTRODUCTION

With more than 10 years of experience in radio communication technologies and field interventions, we have designed this ARM product range, a new generation of radio modem. We have integrated inside all our know-how and the digest of various requirements from different users. For that reason, the ARM (Advanced Radio Modem) range, as indicated in its name, is very versatile and is available in a multitude of versions.

1.2 GENERALITIES

The purpose of a radio modem is to replace a wired link by establishing a High Frequency communication between 2 or several remote points.
The ARM radio modem fits with a large demand in this area by offering a cost-effective and high performance solution. It is an open system with many extension and configuration possibilities as well as a large selection of frequency band.

The ARM product can be used for remote control, supervision, telemetry, data transfer, etc., everywhere where cabling is sensitive and expensive (dams, remote weather stations, ski runs, …), as well as for mobile applications (vehicles, conveyors, travelling cranes, cranes, robotics, etc.).

Its polyvalency allows it, either to transfer information from one point to another or to manage different types of input and output over large distances. Its modularity allows to add, either standard inputs-outputs or specific modules on request.

1.3 AVAILABLE VERSIONS

- ARM-D « **D**igital » radio modem, 2 digital inputs and outputs
- ARM-DA « **D**igital + **A**nalog » radio modem, idem + 1 analog (4-20mA) input and output
- ARM-S « **S**erial » radio modem, RS232/485 + 1 digital input and output
- ARM-CS « **C**ompact **S**erial » IP65 radio modem, RS232/RS422/RS485
- ARM-E « **E**thernet » radio modem (RJ45 connector) + 1 digital input and output

Extension modules (require a basic ARM-S or ARM-E Radio modem):

- ARM-X8800 8 digital inputs and outputs.
- ARM-X4440 4 dig. inputs + 4 dig. outputs + 4 analog (4/20mA or 0/10V) inputs*
- ARM-X4404/I 4 dig. Inputs + 4 dig. Outputs + 4 analog (4/20mA) outputs
- ARM-X4404/U 4Din, 4Dout + 4 analog outputs 0/10V

(*) PT100 and thermocouple versions available soon

Radio board :

- 433MHz / 10mW ARM-v**4/10** (v= S or E)
- 868MHz / 500mW ARM-v**8/500**
- 2.4GHz / 100mW ARM-v**24/100** (2.4GHz ZigBee version available soon)

1.4 OPERATING PRINCIPLE

Very easy to use, the A.R.M. radio modem is entirely configurable using a simple terminal with Hayes commands or with the Windows-based utility « **ARM MANAGER** ».

User can setup the operating mode for its application: transparent, securized, repeater, mirror or Modbus protocol (gateway or slave).

All these capabilities are integrated in standard in the basic of the ARM's firmware.

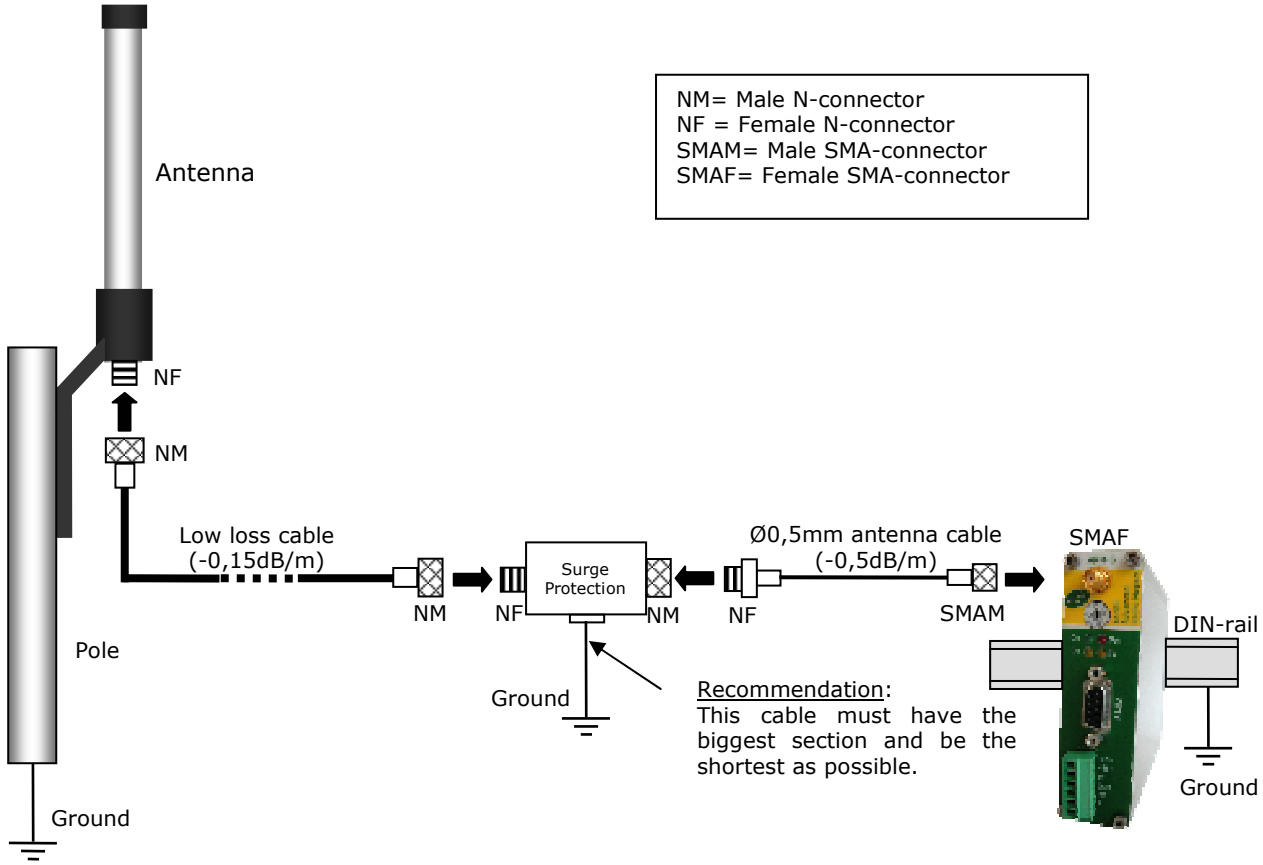
The transparent mode is the default mode which requires not any setting. This mode is suitable for most cases where a protocol is managed by the client device (For instance PLCs communicating in Modbus protocol).

Refer to the User Manual for further information on the operating modes.

2 INSTALLATION

Before setting the product, please read the following recommendations:

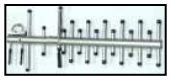
- Do not plug 110 or 220V power supply to the radio modem (max. voltage: 30 Vdc)
- For your security, the connection of the power supply to the ARM radio modem must be realized power off. Check the module's power supply is cut before all intervention.
- The ARM radio modem's power supply voltage must be between 10 and 30 Vdc.
- Do not install directly the ARM radio modem in outdoor. It is not waterproof and if such installation is required it needs to be integrated in a waterproof case or electrical cabinet (in option on request).
- Before connecting or disconnecting the antenna, make sure to discharge to the ground, static electricity as the antenna input is very sensible.
- Connect the metal DIN rail and consequently the ARM to the ground.
- If the antenna is fixed to an outdoor pole, the later must be also connected to the ground. A surge protection module must be inserted on the antenna cable, between the antenna and the ARM radio modem as shown here below.
- Respect the standards by using only recommended cables and antennas in order to be within the ERP authorized by the regulations.



<Figure 1> ***The use of RG58 (-1dB/m) antenna is not recommended***

2.1 ANTENNA

Most problems in radio communication are mainly due to carelessness of antenna's installation.

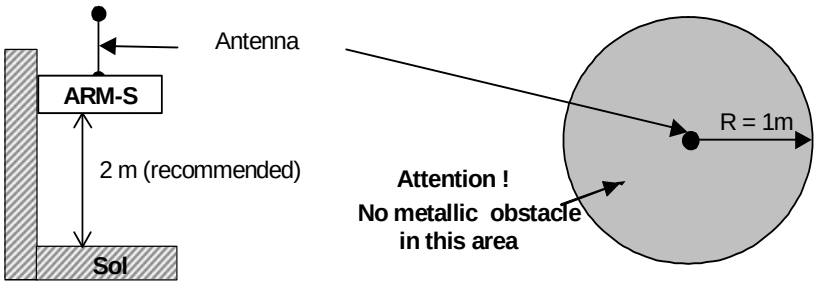
ANT868-14S-L		¼ wave length roof antenna with cable (length: 0.5, 1 or 3m80)+male SMA-connector
ANT868-12FSC		½ wave length bent whip antenna +SMA (direct mounting on ARM)
ANT868-12S-L		½ wave legth roof antenna with cable (length: 0.5, 1 or 3m80)+male SMA-connector
ANT868-BZ		4.15dBi omnidirectional "Bazooka" antenna for pole mounting (with fixing brackets)+ female N-connector
ANT868-Y10		10dBi oriented 8-element Yagi antenna (fem N-connector) Important: make sure the use of this antenna is in compliance with the ERP authorized by the regulations.

2.1.1 Electrical case or cabinet mounting

The ARM radio modems can be supplied with a ½ wave length bent whip antenna in order to keep the antenna vertical on the radio modem.

This antenna is interesting if the ARM is mounted in a plastic case. Thus, the antenna must not touch the metallic back plane of the case. The ½ wave length antenna doesn't require ground plan and can be mounted directly on a non-metallic surface.

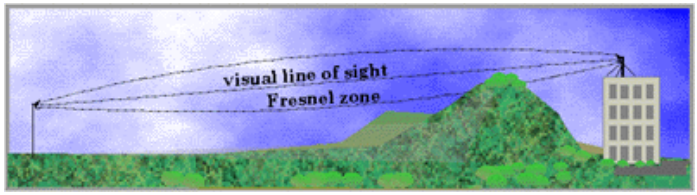
If the radio modem is mounted in a metal case or cabinet, the ¼ wave length antenna (ref. ANT868-14S) can be used. The antenna must be mounted vertically upward or downward depending on the coverage area. For optimal results, it is recommended to place it in high position and without any metallic obstacle within 1 m radius as possible.



2.1.2 Outdoor pole mounting

In this case, you can use the ref. ANT868-O5 antenna with the ref. CFP10 cable type (low loss 10mm diameter). The length of this cable is a factor of signal reduction (We can calculate the ERP of your radio modem installation between two points, therefore we need to have the length of this cable, the distance between the two concerned antennas and the antenna gain). Don't use any co-axial or RG58 cable which induces big loss at this frequency. (cf. diagram above).

In radio communication there is an ellipsoidal volume between the 2 antennas, called « Fresnel zone » (cf. here below). The farer is the transmission, then the antennas must be raised up according to the following rule: approx. 1m high per km between the antennas (for instance for 5km, you must position the antennas at 5m high) in order to avoid all obstacles in this zone. In an open field and at sight, with the antennas installed in compliance with the recommendations, the the ARM range can reach several km.



2.1.3 Spectrum coverage

Priorly to all installation, make sure the selected radio channel is free. For this, use the ARM MANAGER test function "SPECTRUM ANALYZER".

2.1.4 Transmission range

The range of the ARM-S-8/10 radio modem (868MHz/10mW) is at least 1km in open field (even 2km or over if the local noise is low).
The range of the ARM-S-8/500 (868MHz, 500mW) is over 5km in open field.

2.1.5 Channel selection

The radio channel's selection is set usually thanks to the coding wheel, but it is also possible to make it by using Hayes commands. The new channel number will be effective on the next power on. The coding wheel has 16 positions from "0" to "F" (hexadecimal) corresponding a step of 50KHz between 2 positions.

The configuration of the radio modem must respect the standard and therefore, the parameters must also comply to the duty cycle. The ERP is different depending on the selected channel as shown here below:

Channel	Frequency (MHz)
0	869.800
1	868.075
2	868.125
3	868.175
4	868.225
5	868.275
6	868.325
7	868.375

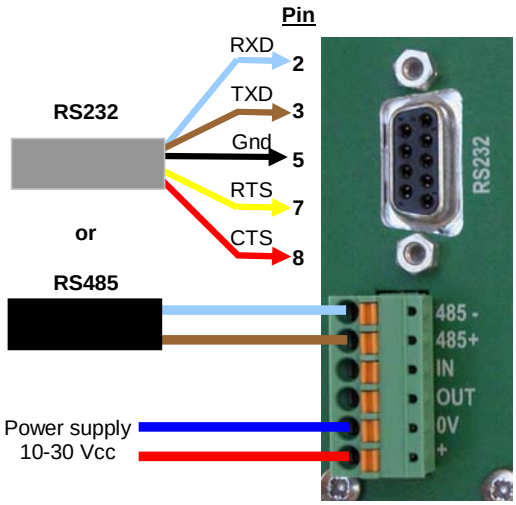
Channel	Frequency (MHz)
8	868.425
9	868.475
A	868.525
B	869.850
C	869.900
D	869.475
E	869.525
F	869.575

Max. ERP : 25mW Duty cycle : 1%
Max. ERP : 5mW Duty cycle : 100%
Max. ERP : 500mW Duty cycle : 10%

For enabling communication between ARM's modules of an application, a same channel number must be set on all the concerned modules. To select a channel with the coding wheel, cut the radio modem's power off, select the channel number using a screw driver and put the radio modem's power on again.

Note: in the case another radio modem, not belonging to the same application, is placed next to those of the main application, make sure to leave at least a free channel between the 2 channels of the 2 applications : application 1-Channel #2 and application 2-Channel #4, for example.

2.2 Radio modem connections



Connection diagram

2.2.1 Power supply

Connect the power supply on the « 0V » and « + » of the spring-cage plug connector.
The voltage must be between 10V and 30V, rectified and filtered.
Warning! Some bad quality 220V power supply may deliver some picks lower than 10V.
The « 0V » (negative pole) is connected to the case and consequently to the ground through the DIN rail.

The consumption under 12V is:

- ~ 25mA in reception
- ~ 50mA in transmission at 10mW
- ~ 350mA in transmission at 500mW
- 0.6mA in standby mode (LEDs off)

2.2.2 Serial RS232

This port can be used either for configurating the radio modem or for communicating with the serial device.

Attention !
The serial interface is a DCE type and a 9 pin male/female right cable must be used for connecting to a PC.
By default, the selection of RS485 or RS232 is automatic when using a 9 pin cable (requiring at least 5 signals Tx, Rx, Gnd, Rts, Cts). It is also possible to force the RS232 or RS485 mode. (cf. register S16).

Sub-D 9 pin assignment

2	RXD	Output	Data transmission/Host reception
3	TXD	Input	Data reception/Host transmission
5	GND	-	Ground
7	RTS	Input	Request to send
8	CTS	Output	Clear to send

The RTS/CTS flow control is configurable in the register S16 (Desactivated by default) and must be activated if the serial port baudrate is higher than the radio one (19.200bps by default).

Warning! The serial RS232 cable must be shielded and must not exceed 3m. For longer length, use a RS485/RS232 converter.

2.2.3 Serial RS485

This port can be used either for configurating the radio modem or for communicating with the serial device.
The advantage of the RS485 is to enable a multi-point connection on a 2-wire cable (A, B or respectively « + » and « - »). This type of interface is currently used in industrial applications due to its low sensibility to EM perturbations (differential transmission) and operates on long distance (up to 1km at 9.600bps according to the standard).

Attention !
By default, the selection of RS485 or RS232 is automatic. When using the RS485 interface, nothing must be connected on the RS232 (SubD) port. It is also possible to force the RS232 or RS485 mode. (cf. register S16).

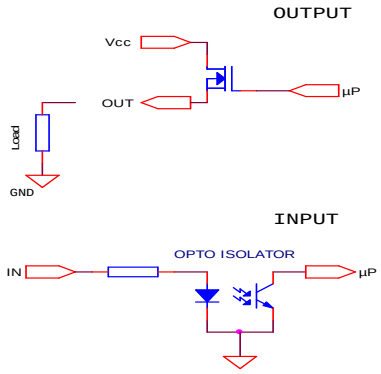
The RS485 requires a 120Ω termination resistance on both ends when the cable is very long or the environment is disturbed. If the serial RS485 cable between the device and the ARM radio modem an the environment is not disturbed, it is recommended not to put the termination resistance in order to reduce the wasted power. The line needs also to be polarized on at least one of the devices connected on the bus.
The dip-switches in the back of the ARM radio modem allow to activate or desactivate the termination resistance and the Pull-up, Pull-down (Picture here below).

Desactivated ↔ Activated
4 : Test mode
3 : Pull-up 2.7K
2 : Pull-down 2.7K
1 : Termination 120Ω

Dip-switch configuration

2.2.4 Digital input and output

The ARM-S radio modem is equipped with one digital input (IN) and one digital output (OUT) in addition to the serial port.
The digital output can be used as a watchdog in case of radio communication failure between 2 or more devices. It is possible to command the digital output or to read the digital input by using Modbus protocol. In this case the ARM radio modem behaves like a slave Modbus in addition to its radio gateway fonctionnality. Refer to the User Guide for the configuration of this output.



Internal diagram of digital inputs-outputs

3 CONFIGURATION

3.1 RADIO MODEM CONFIGURATION

The radio modem has a configuration by default in the firmware (Eeprom), which can be modified according to the requirement of the application. This modification can be done, either in factory, either by using Hayes commands or Windows-based "ARM Manager" utility via the RS232 port.
On reset, the system controls the presence of valid data in Eeprom which will be loaded as standard configuration. If not, the default configuration on the Eeprom will be loaded instead.
The ARM has several operating modes.
Each modem has a unique identification address defined in factory (16-bit with expansion possibility).

3.2 CONFIGURATION WITH WINDOWS-BASED UTILITY « ARM-MANAGER »

Its utilization is quite intuitive and every box has its online help. Connect the ARM radio modem to the PC's serial port and start the utility. The PC's serial port must be priorly selected and configured once by using the option « Tools » of the toolbar's menu.
Then click on the « READ MODEM » button and the PC recovers all the parameters stored in the Eeprom memory of the radio modem.
Then user can select the mode and modify the different parameters. At the end, he only has to click on "WRITE MODEM" button in order to write the new parameters in the Eeprom. The parameters can be saved in a file or uploaded (Option"File" of the toolbar's menu).

3.3 CONFIGURATION USING HAYES COMMANDS (AT)

The AT frame must be sent to the ARM with the programmed UART format (by default: 19,200bps, 8 bits, no parity, 1 or 2 stop bits).

→ If you don't remind the last recorded format, it is possible to return to the configuration by default of the UART by going into the test mode #12 (see test mode here below).

See table of AT's registers ---------- > Appendix A

Exemple :

+++	'Go into command mode
ATS02	'Read S02 (Tx channel)
S02=0E	'Reply : channel = E
ATS02=09	'Write Tx channel = 9
S02=09	'Confirm write into S02
AT&W	'Save parameters in Eeprom
ATR	'Reset modem

4 OPERATING MODE

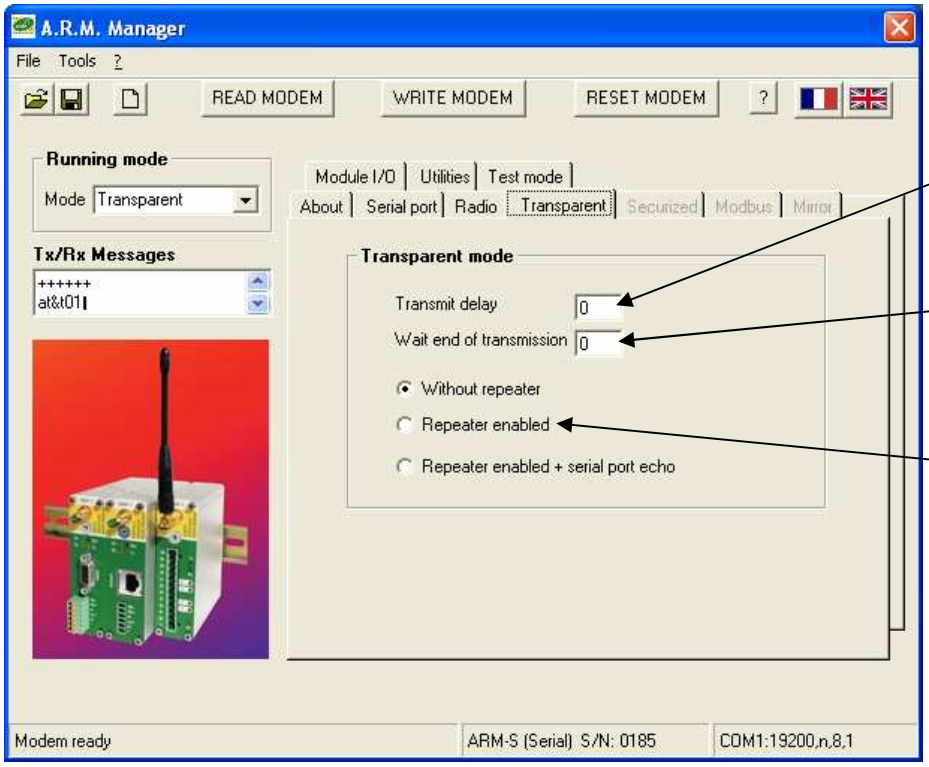
4.1 TRANSPARENT MODE

In this mode, only the handling of the physical layer of the data is realized: each incoming byte of the transmitter module is copied into the receiver module. No error protocol is managed. It is possible to establish a point-to-point or multi-point link. A communication protocol must be enabled on the devices connected to the radio modem (for instance: PLCs with Modbus, Unitelway protocol or else).
Note : in this mode, radio transmission is not a 100% reliable media, therefore the data could be corrupted from time to time and must be repeated as necessary.

Format of radio frame:
- Sync bits (N bit synchronization)
- Message (x bytes)

[Header]	**[Data]**	**[End Sequence]**
3.3ms	8b x n x 52µs	6b x 52µs

(n: number of bytes of incoming frame)



Number of required silence bytes at the end of the incoming frame (for switching in radio transmission mode).

Silence required after the last radio transmitted byte (for switching in radio reception mode). Time= n x 312µs

Caution: to use the repeater, it is necessary to add at least 1 or 2 bytes to « Transmission delay ».
The feature of the repeater is basic : it buffers only the received frame for retransmitting it later.

The radio modem will switch in transmission when receiving the first incoming byte of the serial link (+ eventual delay timer ***« Nr of Bytes before tx » (register S17)*** corresponding to the transmission time of these n bytes at the baud rate of the serial link: for instance 1 ms for 2 bytes at 19200bps). This timer is reset to zero at every reception of a byte on the serial link. In fact, there must be a silent time corresponding to the transmission time of these "n bytes" before starting the transmission.

The transmission goes on as long as the reception buffer of the serial link is not empty. At the end of transmission of the last byte of the buffer, a timer starts to maintain in transmission mode during the time of n bocks of 312µs corresponding to n packets of 6 stop-bit. This time is adjustable by the value of **« Nr of stop frames after Tx » (register S18).** This timer is set for every new frame's transmission.This value must be identical for all connected ARM in the same application.

If the baud rate of the serial link is equal to the radio one, then the data are sent directly.
If this baud rate is lower than the radio one, then the utilization of the timer after their transmissions avoids the swapping of the modem in reception mode and time loss (switching time Tx>>Rx>>Tx).
If this baud rate is lower than the modem one, the data are sent directly while the incoming bytes are stored progressively in the 250-byte buffer of the modem. If the buffer is full, then the modem can't take anymore into account the incoming data of the serial link which are lost. In this case, CTS and RTS flow control signals must be used imperatively, the last one is activated when the number of bytes in the reception buffer reaches 240.

Repeater option
In transparent mode, the operation of the repeater is simple: it memorizes only incoming frame (max. 250 bytes) and retransmits it once at the end of its reception.
- Repeater mode with data forwarding on serial link option (Bit 5 of register S00)
- Repeater mode without data forwarding on serial link option (Bit 4 of register S00)

With Hayes commands, registers to be configured in transparent mode: S00, S17, S18.

4.2 SECURIZED MODE

In securized mode, the radio modem manages the communication as well as the communication errors. A master modem can manage several slaves.

Format of radio frame:

[@Local] [@Destination] [@Repeater] [Control] [Length] [Data] [CRC16]

@Local : local address (16 bits)
@Destination : destination address (16 bits)
@Repeater : repeater address (16 bits) (optional according to flags S00, bits 4 and 5)
Control : control byte (Nr. of repetition, repeater mode, etc.)
Length : length of the incoming data from 1 to 250 (8 bits)
Data : incoming data from serial link for transmission
CRC16 : 16-bit frame control algorithm

In this mode, 3 feautures are available:

1 – Point-to-point communication
Just define the local address and the destination address for every modem (respectively registers S08 and S09).

2 – Dialing mode communication « ATD »:
Then the radio modem behaves as a standard telephone modem. By default, it is in command mode and expects an « ATDxx » command, where xx represents the destination address (in ASCII from 1 to 99).

Example of connection :

ATD02 'The modem @01 calls the remote modem @02

RING '(serial port of modem @02)
CONNECT '(serial port of modem @01 and @02)

[Connected mode ….Bidirectional securized communication….]

Automatic disconnection after security time-out (S52,S53) and return in command mode.

Call modem @02 with repeater: **ATD03,02** 'The modem @03 is the repeater

Attention: the DCD (Data Carrier Detect) and DTR (Data Terminal Ready) signals are not managed. It is possible to have an alternative solution by using the digital input IN (DTR) and the digital output OUT (DCD) of the ARM (active if connected).

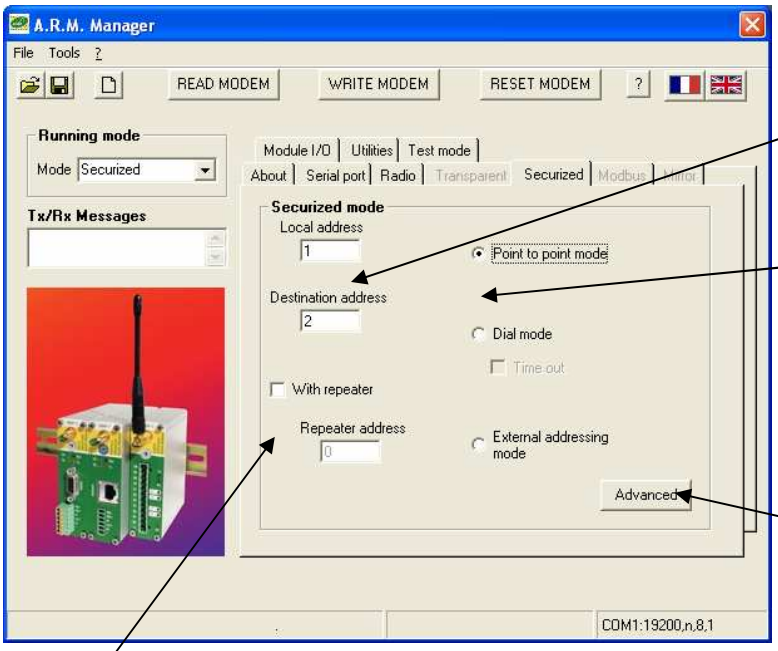
3- Securized mode with external addressing communication

In this case, user must include in the head of his message, 2 bytes corresponding to the address of destination (16 bits). This method allows to address to old devices which are not addressable normally (for instance ASCII scrolling displays).

With Hayes commands, registers to configure in securized mode: S05, S06, S17, S22, S45, S21, S46, S47.

Important remarks:

It is possible to use the RTS/CTS flow control (same as in transparent mode, see previous paragraph).
Every modem can be a repeater, the radio frame can be repeated only once by only one repeater modem.
The configuration must be identical for all the modems used in a same application, except the addresses.
In a configuration with repeater, the register S22 (Nr. of retransmission) must be 0 and the value of the register 21 (ACK frame waiting time) must be doubled.

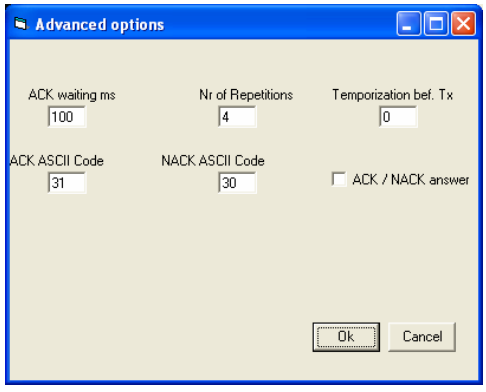


Beware when configurating the local and remote addresses (these addresses are reversed on the opposite modem).

There are 3 different securized modes:

- The simplest one is the point-to-point mode.
- The « dial » mode is used when a master needs to connect to a defined slave among several.
- The external addressing mode is used when the destinee address is included in the frame.

Advanced options thumb (see below) :



Caution: when using with a repeater, the timer before Tx (advanced options) must not be set at 0!
The repeater must be configured in the same securized mode.

In the advanced options, it is possible to adjust the ACK or NACK time-out, the number of repetition on error and the ASCII code for ACK and NACK
(see opposite ->).

4.3 MODBUS MODE

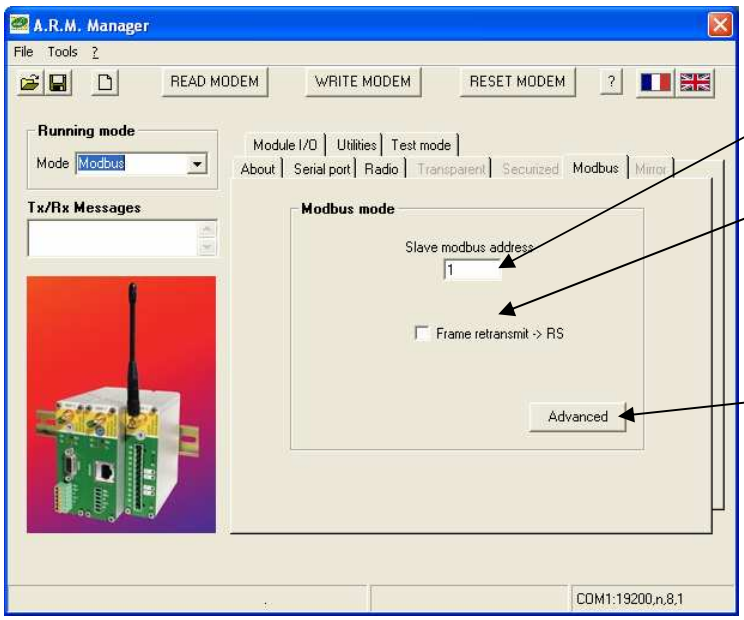
The ARM radio modem works only in Modbus slave.
Two types of communication are possible: the master sends a request to a slave and wait for the answer or the master sends a message to all the slaves without expecting answers (broadcast).
The description of the general communication corresponds to the one described here above, except initialization frame and the type of answer (see description here below):

Format of radio frame (identical request and answer):

[Slave Nr.] [Function] [Data] [CRC16]

Slave Nr.: 8 bits, Nr. 00= broadcast (not expecting answers from all slaves).
Function: Modbus function code $03 (Read) and $10 (Write).
Data : data to read or write
CRC16 : 16-bit frame control algorithm

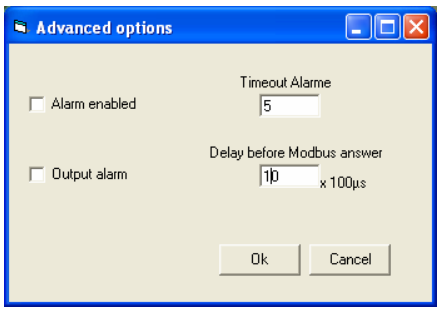
The Modbus frame may come from either the serial link or the radio reception. If the address corresponds to the local address, then the modem decodes the frame, if not it forwards the received frame either on the serial link (radio reception) or in radio transmission (reception on serial link).



Modbus address of the ARM which behaves thus as a Modbus slave, accessible in read/write.

If another Modbus device is connected behind the ARM, the latter behaves as a gateway in addition to its Modbus slave feature. In this case, tick this box.

Advanced features:
The OUT outputs of the ARM can be set as an activated Watchdog alarm when the communication fails. For that, tick the box and adjust the time-out to 5 (for 5 s) for instance.
(see also output fall back feature).



Remark: no repeater mode when using Modbus mode. If the repeater mode is required, then use the transparent mode.

Since the 4.1 version, the RTS signal is used for the reset of the extension modules.
In this case, it is imperative to disable the RTS/CTS flow control (S40_bit4 must be =1).
If the watchdog function is enabled, we can use the RTS signal to reset all the extension modules (S40_bit1).

Timing:
Measure of time between the first byte of the Modbus request transmitted from a modem (in transparent mode) to a distant ARM-X and the last byte of the answer on the same modem.
Function: Read 1 word
- Address $0000 to $04FF: 16ms
- Address $0504 (1 extension module): 40ms
- Address $0504 (2 extension modules): 70ms

MODBUS functions used by the modem:

Read N words register (digital & analogue inputs/outputs + Eeprom) :

<Function $03> <Address first word (0000-FFFF)><Number of register N (0001-007D)>

Answer <function $03><Number of bytes (2*N)><Value register N*2 bytes>

Error <function $83><error code $01 - $04>

Write N words register (16):

<Function $10> <Address word ($0000-$FFFF)><Number of register N ($0001-$0078)>
<Number of bytes 2*N> <Value register 2*N>

Answer <function $10> <Address word ($0000-$FFFF)><Number of register N ($0001-$007B)>

Error <function $90><error code $01 - $04>

The address of the message is composed of 2 parts:
8 MSB bits for the physical address of the I/O board.

ex: MSB=00 -> mother board
MSB=01 -> I/O expansion board 1

8 LSB bits for the address of inputs/outputs of a board with:
LSB=0X : digital input
LSB=1X : digital output
LSB=2X : analogue input
LSB=3X : analogue output
LSB=4X : counter
LSB=4X to 7X not used
LSB=80 à FF Eeprom register

Remark on counters :
The mother board has either a 32-bit counter (ARM-S) or 2 32-bit counters (ARM-D).
The maximum using frequency is 20Hz
This function is validated when the bit 7 of register S34 is set to 1.
User can read counters with 16-bit words and write in these counters (for counter reset)

Address must correspond to:
$0040 : address of mother board input 1 counter 16-bit MSB register
$0041 : address of mother board input 1 counter 16-bit LSB register
$0042 : address of mother board input 2 counter 16-bit MSB register
$0043 : address of mother board input 2 counter 16-bit LSB register

Remark :
The Modbus addresses of all the ARM boards and their expansion boards are defined in the Microsoft Excel file format "ARM Addressage Modbus.xls"

In Modbus mode, the configuration is very simple: there is only the Modbus slave address to configure (S07) as well as the response time (S55) and the Modbus gateway mode (forwarding on the serial link, S00).
In Modbus gateway mode, if the Modbus request is not addressed to the ARM, this one forwards it on its serial port to Modbus devices which are connected to.
Optional: validation of mother board input counters S34=80 (b7 to 1)

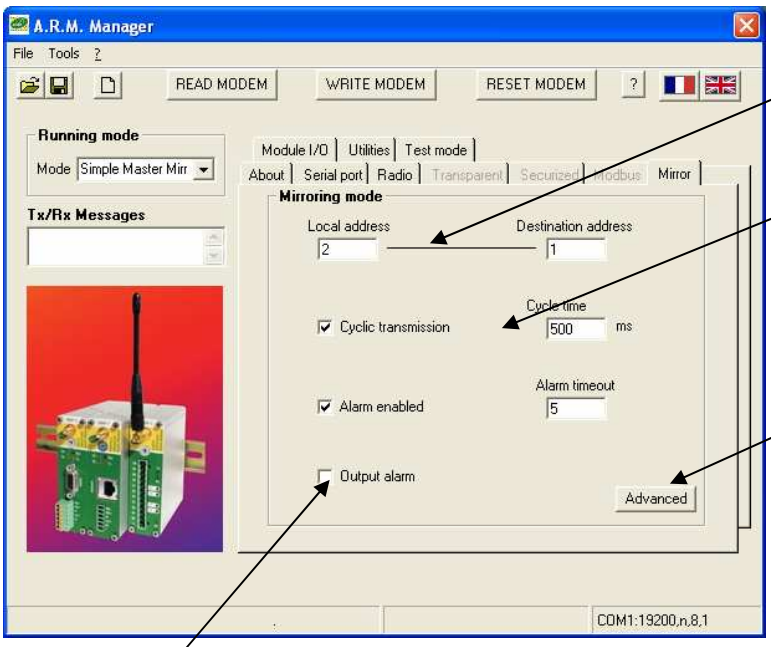
4.4 MIRROR MODE

This mode includes 3 functionalities :

- Mirror mode single master: the master modem and the slave modem have an identical configuration of inputs and outputs. The master modem transmits a radio frame containing the state of its inputs to the slave modem which copies it on its outputs. The salve modem sends back immediately to the master modem the state of its inputs. The master modem sends the frame either according to a defined cycle or on change of state of its digital inputs.
- Mirror mode multiple masters: there is one master module and several slave modules. The slaves modules are identical and can only have 1, 2, 4 or 8 inputs. The master module polls the slave modules one after another. It is configured necessarily in cyclic mode. It sends to the first modem the state of its inputs corresponding to the outputs of the polled slave modem, this one configures its outputs and sends the state of all its inputs to the master modem. After the frame reception and the copy of the slave inputs on its own outputs, the master modem keeps on polling the other slave modems up to the last one. After a defined time, the cycle restarts again.
- Mirror mode slave: on reception of the radio frame transmitted by the master modem, the slave modem copies the remote master inputs on its own outputs and sends the state of its inputs to the master modem. In this mode, a specific function allows, on change of state of inputs, to send a radio frame. The validation is effective by the bit 5 of the S35 register. The timer of registers S28 and S29 (time between 2 controls of inputs) allows to supervise the digital inputs.

Several options are available :

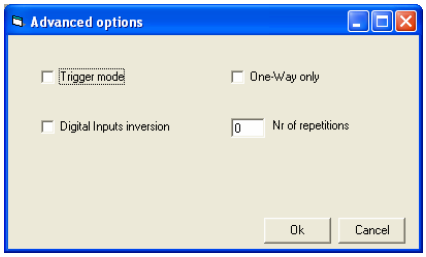
- Cyclic sending
- Sending on change of state of one digital input (Mirror mode single master)
- Transmission frame repetition with inputs rereading (Mirror mode single master)
- No return frame transmission
- Temporizing between 2 reading of inputs. This temporizing allows to space the reading of inputs (possibility of stand-by mode) when the cycle time is long.



Configure the addresses of the 2 radio modems in simple mirror mode (point-to-point). They must be reversed on the opposite modem.

In cyclic mode, tick the box and adjust the cycle time in ms. Every cycle corresponds to a transmission/reception time.

Advanced features:
The « trigger » mode is selected on this screen.
In « unidirectionnal » mode, the master operates with several slaves which must have the same states on their respective outputs.
It is possible to reverse the digital inputs and select the number of repetition (useful in trigger mode). See below:



If the « Alarm activation » is ticked, the output will pull back after the time-out. The ARM's OUT output can be set as activated Watchdog when the communication fails. For that, tick the "Alarm output" case and adjust the time-out to 5 (for 5 s) for instance.

Format of radio frame (identical request and answer):

[@Destination] [Control] [Digital inputs] [CRC16]
8bits 8bits 8bits 16bits

(see ARM-X document for further information).

4.5 WATCHDOG ALARM

The validation of the watchdog allows to control the non-reception of radio frame during a defined time (time-out). On reception of the first defined time-out, the modem reconfigures the different interfaces and activates the output OUT1 of the mother board. On the second time-out, the modem realizes a reset.

Configuration :

- Register S52 (LSB) - S53 (MSB) : by default 20s (time base: 1s)
- S34-b3: Authorization time-out alarm
- S34-b6: Reconfiguration Eeprom if end time-out alarm (if factory configuration identical) – Warning for its use! Risk of lost of modified information.
- S01-b6 : output OUT of mother board activated (1) if end time-out alarm

5 TEST MODE

The test mode can be activated either by Hayes commands or by activating dip-switch 4 on the back of the ARM radio modem (switch to the right) and the coding wheel on the function code number.

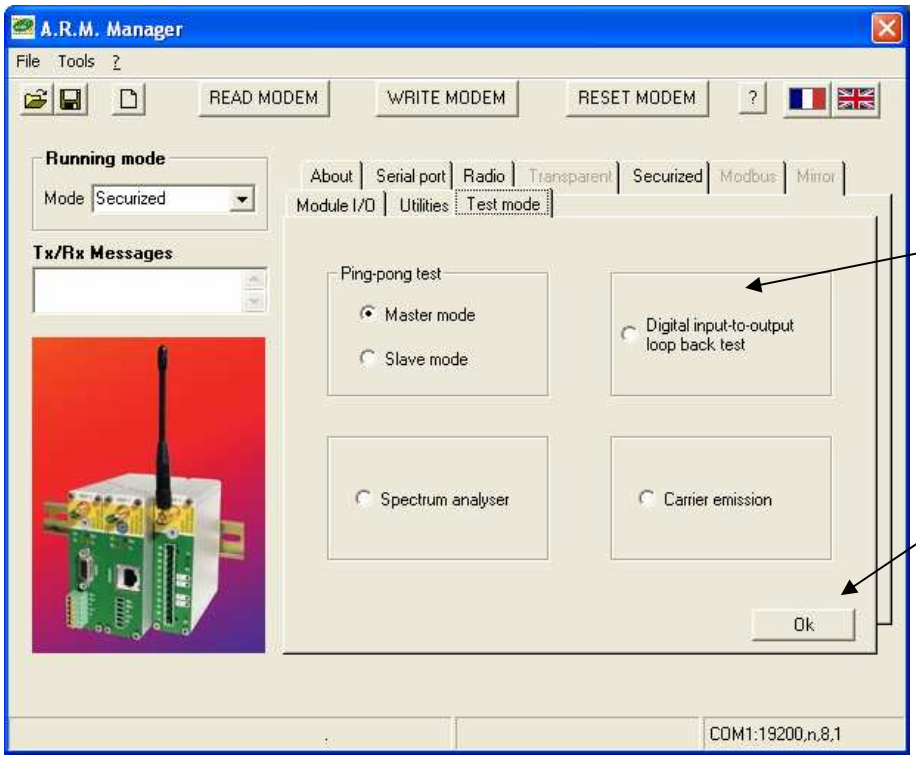
Attention : as the radio channel can't be selected anymore with the coding wheel, it can be set thanks to the ARM MANAGER (Radio parameters) or Hayes commands (S02 : transmission channel and S03 : reception channel). The ERP depends on the selected radio channel (see frequency table).
By default, the test channel is the « E » one (869.525MHz / 500mW). These values are not modified and therefore it is not possible to reprogram it every time.

Tips *-> With the ARM MANAGER utility, user can force the radio channel (on E for instance), write this configuration in the modem and then ticks off the « Force radio channel » box and rewrite in the modem. In normal mode, the channel will be the one selected by the coding wheel but when user switch to test mode, the channel E (500mW) will be used.*

Test mode functions : (Dip switch 4 ON)

Test 1 (Coding wheel =1)	Looping of digital output on digital input
Test 2 (Coding wheel =2)	Read Eeprom configuration and send to RS232
Test 3 (Coding wheel =3)	Transmit carrier
Test 4 (Coding wheel =4)	Transmission of numbered frames of 250 ASCII characters every 200ms
Test 5 (Coding wheel =5)	Reception of data on RS232
Test 6 (Coding wheel =6)	Read RSSI and send value on RS232 Bit2 register S49 = value 16 channels (bit=0) Bit2 register S49 = value 1 channel (register3) (bit=1)
Test 7 (Coding wheel =7)	Master PING PONG Transmission of 250 characters and waiting in reception for 250 characters Send on the RS232, the number of received characters
Test 8 (Coding wheel =8)	Slave PING PONG Waiting in reception for 250 characters then transmission of 250 characters Send on the RS232, the number of received characters Since Version 4.0: If reception of 250 good characters: Rx led ON (Green) If reception of only 1 to 249 good char. : Rx Led + Sys Led ON If reception 0 good char. : Sys led ON (Red) If no reception: Rx and Sys leds OFF
Test 9	Do not use
Test 10	Do not use
Test 11	Do not use
Test 12 (Coding wheel =12)	Serial link parameters reconfiguration: 19200/8/N/1 forced RS232 mode
Test 13 (Coding wheel =13)	Eeprom reprogramming with default values

TESTS WITH ARM MANAGER UTILITY

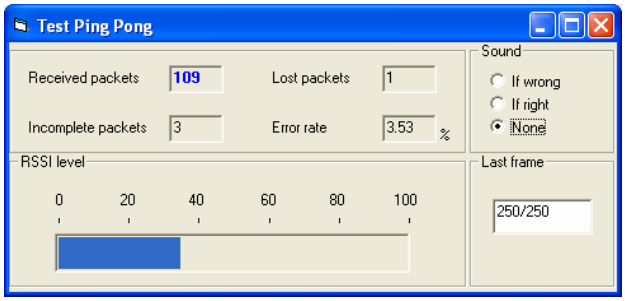


Select the test among :

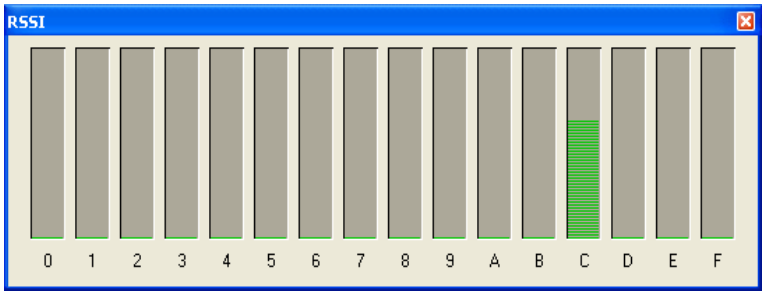
- Ping-pong test
- Input-output test
- Spectrum test
- Carrier transmission

Then click on OK to launch the test.

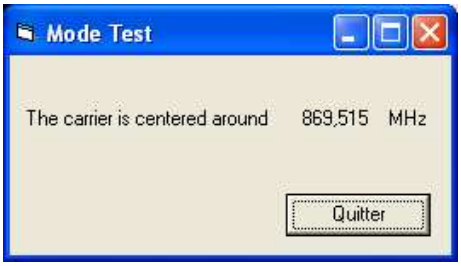
Statistics in « ping-pong » mode
(Radio Tx/Rx of message of 250 characters) :



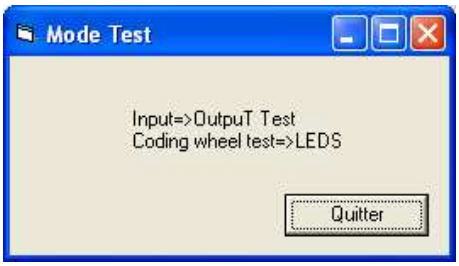
Spectrum analyzer test: 16 radio channel scan.
Launch this test priorly to all installation for identifying free channels.



Carrier transmission test :



Coding wheel, leds and I/Os test :



APPENDIX A – AT COMMANDS

Commands	Functions
AT	Mandatoty prefix for all Hayes commands
O	Switch to communication mode (transparent)
&W	Write registers in Eeprom (Proceed only when its content has been modified)
&F	Restore default parameters and reset the Eeprom
In	n=0 Boot version n=1 Firmware version n=2 Card ID Address n=3 Country code + Application code
+++	Return to Hayes mode
ATR	Reset
ATDxx	Dial Mode (securized mode) Call distant modem xx (1 – 99)
&T0	Exit Test mode
&Tx	Test functions (x= 1 to 12)
Sxx ?	Read register x and return hexadecimal value (? optional)
Sxx=nn	Write nn (value in hexadecimal) in register xx

NOTES: All Hayes command lines must be terminated by « CR » (Carriage Return)

The Hayes command frame must be sent to the ARM under programmed UART format (by default: 19.200bps, 8 bits, no parity, 1 or 2 stop bits).

If you don't remember the last registered format, it is possible to come back to the default UART configuration by using the test mode "12" (cf. Test mode).

Nr	Utilization of register
S00	Application Register1 : see details
S01	Application Register2 : see details
S02	Tx Channel (transmission): $00 à $0F
S03	Rx Channel (reception): $00 à $0F
S04	Tx Power Selection (default $FF)
S05	Securized Mode : Destination Address LSB
S06	Securized Mode : Destination Address MSB
S07	Local Address 8 bits (Securized and Modbus Modes)
S08	Mirror Mode: Local Address
S09	Mirror Mode: Destination Address
S10	Repeater Address LSB
S11	Repeater Address LSB
S12	RS232 Baud Rate $00=1200 ; $01=2400 ; $02=4800 ; $03=9600 $04=19200 ; $05=38400 ; $06=76800 ; $07=115200
S13	RS232 Data Bit : $07 ou $08
S14	RS232 Parity : bit0 : = 0 parity disabled ; = 1 parity enabled bit1 : = 0 odd parity ; = 1 even parity

S15	RS232 Stop Bit = 1
S16	RS232 Flow Control bit0 : = 0 no flow control ; = 1 CTS/RTS bit6 (manual interface selection) : = 0 RS232 ; =1 RS485 bit7 : = 1 enable automatic serial interface detection
S17	Time before Radio Tx : Number of required silence bytes at the end of the incoming frame (for switching in radio transmission mode).
S18	End Tx wait: Number of required silence bytes after the last radio transmitted byte (for switching in radio reception mode).
S19	Time RX LED On (LSB) time base:1ms
S20	Time RX LED On (MSB) time base:1ms
S21	Securized Mode : Wait time ACK (time base: 1ms)
S22	Securized Mode: Number of Tx (radio) repetitions if error.
S23	Mirror Mode: Wait time Rx (radio) (tb :1ms) Master: $20 / Slave: $0A
S24	Mirror Mode: Number of Tx (radio) repetitions
S25	Mirror Mode: Cycle time between 2 messages LSB tb :245µs
S26	Mirror Mode: Cycle time between 2 messages MSB tb :245µs
S27	Mirror Mode: Counter * Cycle Time (for long cycle time)
S28	Mirror Mode: Time between 2 reading of the inputs LSB (tb :245µs)
S29	Mirror Mode: Time between 2 reading of the inputs MSB (tb :245µs)
S30	Application Register 5 : See details (F/W V3.5 ->)
S31	Reception wait time (tb :1ms)
S32	RSSI value (Receive Signal Strength Indicator)
S33	Do not change !
S34	Application Register 3: see details
S35	Application Register 4: see details
S36	Radio reception timeout (tb:1ms)
S37	Do not change !
S38	Do not change !
S39	Do not change !
S40	Application Register 6 see details
S41	Preamble code
S42	Do not change !
S43	Multi-Mirror Mode : Errors counter
S44	Multi-Mirror Mode : Time between 2 messages
S45	Securized Mode: Number of bytes in buffer
S46	Securized Mode : ACK ASCII Code (sended to RS232)
S47	Securized Mode : NACK ASCII Code (sended to RS232)
S48	Do not change !
S49	Do not change !
S50	Do not change !
S51	Do not change !
S52	Watchdog: Time out if no radio reception LSB (tb :1s)
S53	Watchdog: Time out if no radio reception MSB (tb :1s)
S54	RS485 Back Time modulo 5µs (Do not change !)
S55	ModBus Mode: Time before sending ACK (tb :100us)
S56	Do not change !
S57	Do not change !
S58	Tx preamble
S59	Rx preamble

S60	Extension card 1 enabled
S61	Extension card 2 enabled
S62	Extension card 3 enabled
S63	Extension card 4 enabled
S64	Number of digital inputs - Extension card 1
S65	Number of digital inputs - Extension card 2
S66	Number of digital inputs - Extension card 3
S67	Number of digital inputs - Extension card 4
S68	Number of digital outputs - Extension card 1
S69	Number of digital outputs - Extension card 2
S70	Number of digital outputs - Extension card 3
S71	Number of digital outputs - Extension card 4
S72	Number of analog inputs - Extension card 1
S73	Number of analog inputs - Extension card 2
S74	Number of analog inputs - Extension card 3
S75	Number of analog inputs - Extension card 4
S76	Number of analog outputs - Extension card 1
S77	Number of analog outputs - Extension card 2
S78	Number of analog outputs - Extension card 3
S79	Number of analog outputs - Extension card 4
S80	Multi-Mirror Mode - Number of modems
S81	Multi-Mirror Mode - Number of bytes in radio header

Application Register 1 :

b0-b3: 0 Transparent Mode
1 Securized Mode
2 Modbus Mode
3 Simple Master Mirror Mode
4 Multi-Mirror Mode
5 Slave Mirror Mode

b4 : Repeater Mode
b5 : Repeater Mode with messages on the serial port
b6 : ModBus Mode: Enable Messages on the serial port
b7 : Securized Mode: Enable ACK NACK on the serial port

Application Register 2 :

b0: Mirror Mode: Enable Dig. I/O ("IN"/"OUT") of the main module (ARM-D)
b1: Mirror Mode: Enable analog I/O of the main module (ARM-D)
b2: Mirror Mode: Inputs inversion
b3: Mirror Mode: Cyclic mode.
b4: Mirror Mode: Triggering on state change
b5: Mirror Mode: No radio reply from the slave modem if 1
b6: Mirror Mode: Enable "OUT" of the main module if Alarm Watchdog
b7: Mirror Mode: Wait Rx message Time x 2 (if 1)

Application Register 3 :

b0: Do not modify !
b1: Securized Mode: External addressing Mode (2 first bytes)
b2: Ethernet Mode: Enable « IN » Input of main module for sending E-mail

b3: Enable Watchdog Alarm (Mirror and Modbus modes)
b4: Frequency selection : coding wheel (0) or AT register (1)
b5: Enable Sleep Mode
b6: Enable Eeprom reinitialisation if Alarm Watchdog
b7: Enable main module inputs counters (Modbus Mode)

Application Register 4 :

b0-b6: Do not modify !
b7: Radio: enable preamble register

Application Register 5 :

b0: Securized Mode: Sélect Local Address using Register S07 (default)
b1: Securized Mode: Select “Dial” mode (Securized Mode)
b2: Securized Mode: Enable Timeout for “Dial” Mode
b3-b7: Do not modify !

Application Register 6 :

b0: Radio: Enable RSSI function
b1: Radio: Enable code in preamble
b2: non used
b3: non used
b4: Do not modify !
b5: Do not modify !
b6: non used
b7: non used

Attention :
All modification of configuration parameters (in AT mode) will result modification of current program. If the incoherent data are stored, dysfunction may occur.
It is strongly recommended to use, if possible, **ARM MANAGER utility** for avoiding such trouble.